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Bækbo, Martin Jesper; Mei, Bastian Timo; Bae, Dowon; Seger, Brian; Vesborg, Peter Christian Kjærgaard; Chorkendorff, Ib

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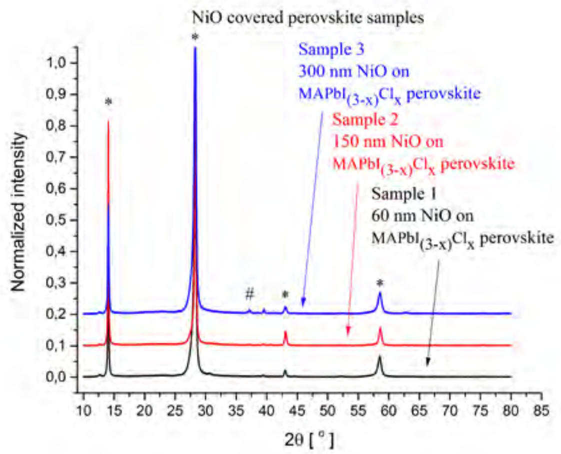
Protected methylammonium lead halide perovskite photoelectrodes for efficient two-photon water splitting

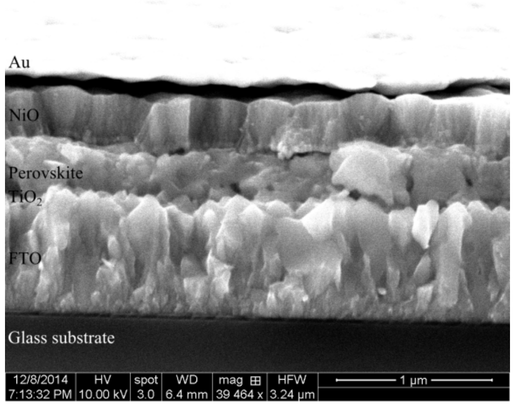
*M.J. Bækbo** (1), B. Mei (1), D. Bae (1), B. Seger (1), P. C. K. Vesborg (1), I. Chorkendorff (1)*

(1) DTU Physics, Technical University of Denmark, Copenhagen, Denmark

*Corresponding author email: majeba@fysik.dtu.dk

The production of sustainable energy has in recent years received an increasing amount of attention due to the environmental consequences of using fossil fuels to power society. Windmills and photovoltaics are among the most common technologies for producing 'green' energy which, however, both have the drawback that the electricity that they produce is hard to store efficiently. Storing excess energy in chemical bonds offers a way to negate this problem and using hydrogen as energy carrier offers many advantages. To produce the hydrogen the approach proposed here is to utilize a monolithic two-photon tandem photoelectrochemical (PEC) cell which can theoretically yield a solar to hydrogen (STH) efficiency of 22.8% by splitting water [1]. In the device a large band gap (LBG) material is placed on top of a smaller band gap (SBG) material where the overall band gap of the optimal device should be 2.7 eV [2]. The LBG material suggested is methylammonium lead halide perovskite ($CH_3NH_3PbX_3$, X = I, Br, Cl) which offers a high absorption in the visible range, low price, and a tuneable band gap depending on the halogens included in the structure [3]. The major drawback of using perovskite is that it decomposes very rapidly in water meaning that a pin hole free protection layer is paramount for ensuring device functionality. NiO is envisioned as the protective layer, in case the LBG electrode is used as anode, as is features a good stability while being a decent catalyst for the oxygen evolution reaction [4].





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